Oregon Department of Transportation

Paving the Way for Better Transportation

Research, Development & Technology Transfer Program

Annual Report
2007

Planning + Economic Analysis	Construction + Maintenance	Pavements + Materials	Hydraulics, Geotechnical + Environmental	Integrated Multimodal	Roadway Design + Human Factors	Traffic + Safety	Structures

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I. INTRODUCTION

The Oregon Department of Transportation's (ODOT) Research Unit is organizationally located within the Planning Section and the Transportation Development Division. The Research Unit oversees the state's federally funded research, development and technology transfer program with particular emphasis on new technology intended to enhance the performance of Oregon's transportation systems. Research topics typically address transportation safety, sustainability, and cost savings. Some of the main topics addressed by research include: safety, infrastructure repair and preservation, construction and maintenance practices, environmental impacts, sustainable environmental practices, mobility options and planning.

This is the sixth edition of the ODOT Research, Development and Technology Transfer Program *Annual Report*.

OVERVIEW

Research plays an important role in management of Oregon's transportation systems. The impacts of Oregon's continuing population and economic growth have important consequences for transportation demand, as well as wear and tear on the transportation infrastructure. The rising cost of operating, preserving and maintaining highway infrastructure leaves few resources for highway expansion or modernization to keep pace with growth. Research efforts help contribute to development of improved materials and methods that optimize available resources and funds.

Ideas for research projects come from numerous sources. Through an annual solicitation process an interested party or individual may submit a written proposal, called a "problem statement," which outlines their research idea. The proposals will go through more than one stage of review before they are accepted for funding. A total of 120 proposals were received in Fiscal Year (FY) 2007, and of those, 31 were passed on to a second stage of review.

The selection process for research projects in FY 2007 was different from past years due to the creation of the Oregon Transportation Research and Education Consortium (OTREC), located at Portland State University. OTREC was created by the most recent Federal transportation authorization bill, which provides for up to $3.5 million per year for transportation research and education. Several ODOT research problem statements were also submitted to OTREC. By matching ODOT funds with OTREC funds, ODOT Research was able to stretch its dollars further.

In FY 2007, ODOT Research spent approximately $2.5 million on research projects and activities that directly supported research projects. A total of nine new research projects began in FY 2007, nine research pro-

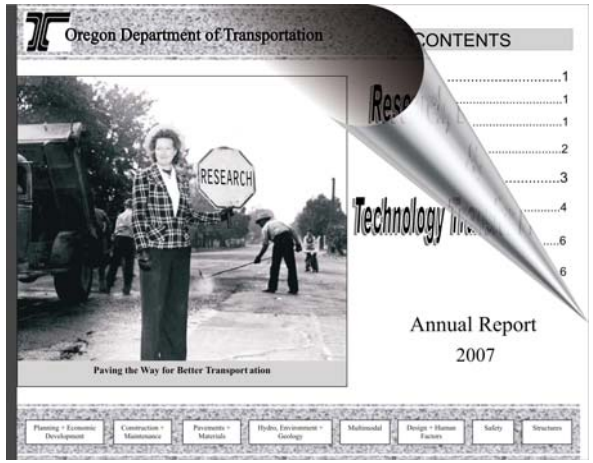
jects were completed, and 10 research reports were published.

ORGANIZATION OF THE REPORT

The main body of this report is organized as follows. Chapter 2 is an overview of the year, noting specific highlights and accomplishments. Chapter 3 summarizes other important completed or continuing research projects. Chapter 4 reports on other accomplishments, including information about project selection, small projects and various ongoing responsibilities. Chapter 5 summarizes completed and continuing projects in tabular form, along with a budget and expenditures summary.

A list of abbreviations is provided as an appendix at the end of this document. There are many names and organizations that are listed throughout the report. When these names or organizations are first listed, the full name will be used and abbreviations will mostly appear thereafter.

Limits on length preclude treating every project in depth. Instead, the focus is on projects of most general interest, representative of a range of topics, and expected to be of the highest value to ODOT.



If you have questions about the contents of this report or about any aspect of Research at ODOT, you may make contact. The contact information is as follows:

ODOT Research Unit
200 Hawthorne Ave. SE, Suite B-240
Salem, OR 97301-5192
Telephone: 503-986-2700
FAX: 503-986-2844
Website: http://egov.oregon.gov/ODOT/TD/TP_RES/

TDD Administrator's Message

Jerri Bohard, Administrator
Transportation Development Division

Building Relationships

An important benefit of research is that it usually has general applicability. Research can be used by many organizations and individuals, independent of the source of the research. Because of this general applicability, it only makes sense for organizations to cooperate and share resources that utilize research to solve common problems.

There are many examples of collaboration in transportation research. States contribute part of their federal State Planning and Research (SPR) funding to the National Cooperative Highway Research Program (NCHRP). The Transportation Pooled Fund (TPF) program allows states to share the cost of research projects.

Closer to home, the ODOT Technology Transfer (T2) Center has a long-established partnership with American Public Works Association (APWA) and local public works agencies, to provide training and technical information. ODOT also has an important and evolving research partnership with state and region universities. For many years that partnership has involved academic researchers at Oregon State University (OSU) and Portland State University (PSU). The partnership also entailed collaborative research funding through Transportation Northwest, which for many years was this region's only University Transportation Center (UTC).

ODOT's opportunities for collaboration with universities is moving to a new level, with the creation of Federally funded UTC's in Oregon and Alaska, in addition to existing centers in Washington, Idaho and Montana.

Efforts to make the most of this opportunity are moving in two directions. Locally, ODOT Research has taken an active role in establishing the Oregon Transportation Research and Education Consortium (OTREC), Oregon's newly designated National University Transportation Center. ODOT was involved in drafting OTREC's strategic plan and is represented on OTREC's Executive Committee and Advisory Board. Internal adjustments have been made to the research program to optimize collaboration with OTREC. It is expected that up to one third of ODOT's future research effort will be funded through a University Transportation Center, most of that being through OTREC.

Regionally, a similar effort has focused on an entity now known as the Region X Transportation Consortium. Membership in this consortium consists of the State DOT Research Programs and the University Transportation Centers in Alaska, Idaho, Washington and Oregon. The goal of this nascent organization is to pool intellectual and financial resources to address the common research and educational interests of the region.

The Region X Consortium is developing several specific collaborative research initiatives. It is also providing an opportunity to build familiarity and trust across state lines, and gives our research program easy access to a broader range of research capabilities within the region.

I am excited about this opportunity. I am also pleased with the effort that has been devoted to these initiatives, and with the progress that has been made.

II. HIGHLIGHTS OF THE YEAR

In Fiscal 2007 there were significant accomplishments in several key areas.

- First, the Research Unit delivered research results that were very beneficial to ODOT.
- Second, the unit improved the unit's track record for timeliness.
- Third, the unit took steps to change existing processes, in order to improve Research's ability to collaborate with its university partners.

DELIVERING RESULTS

Cracked Bridges

Both the 2005 and 2006 editions of this Annual Report highlighted research accomplishments in the area of bridge research. Starting in FY 2001 the Research Unit has undertaken eight related research projects with a total cost of over $3.6 Million, addressing remaining life, load rating methods and repair strategies for cracked reinforced concrete girder bridges. Of the eight projects, all are complete or very near completion.

The result of this focused program of research has been to substantially redirect the $1.8 billion in resources available to the Oregon Transportation Improvement Act (OTIA) III Bridge Replacement Program. Based on improved understanding of bridge behavior along with more refined load rating methods, and more cost effective repair strategies, it was possible to show that many bridges originally slated for replacement or repair could be addressed more economically, or in some cases, taken off the repair and replacement lists entirely. Consequently, available funds through the OTIA III program will address a more substantial share of Oregon's structurally deficient and obsolete bridges. A summary of this research will be published as the "Research Pays Off" feature article in a forthcoming issue of Transportation Research News (TR News). TR News is a bi-monthly publication of the Transportation Research Board (TRB).

Evaluation of Highway Construction Project Delivery Methods

In 2002, ODOT Research started a project with Oregon State University to investigate and evaluate the methods used to deliver highway construction

projects. These projects included bridge repair and construction, capacity improvements through modernization, and maintaining the quality of the highway through preservation. The focus of the research was on projects delivered through the Oregon Transportation Improvement Act and the Statewide Transportation Improvement Program (STIP). The first phase of the research gathered information about three project delivery methods: traditional in-sourced design-bid-build, outsourced design-bid-build, and outsourced design-build. This phase also included a survey of state DOT's and follow-up interviews with 14 states about their project delivery experiences.

From 2004 to 2007 the research monitored OTIA and STIP projects that were outsourced through the design-build and design-bid-build methods and tracked them alongside ODOT's traditional in-house delivered (i.e., insourced) projects. The research collected qualitative data through surveys of ODOT staff on project complexity and the relationship between delivery methods and project performance. The research team also conducted interviews of engineering consultants and construction contractors who have worked on these same ODOT projects.

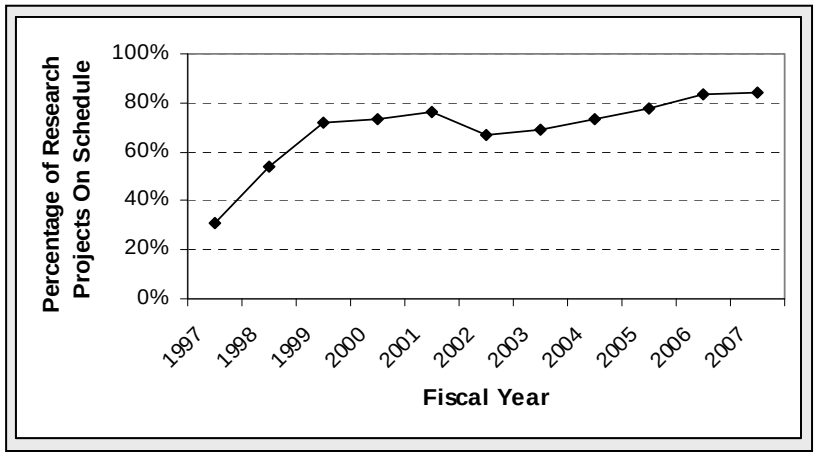
The research found that low numbers of outsourced projects with usable data made it difficult to detect any significant differences between performance measures for insourced and outsourced projects. Thus the conclusions relied more heavily on the interviews with ODOT staff, engineering consultants and contractors. Major conclusions included the following:

- Bridge projects are well-suited for outsourcing because they are typically easy to define, highly technical, require the coordination of multiple engineering disciplines, and ODOT currently lacks adequate staff to perform the work.
- Preservation projects are usually better delivered in-sourced because they are typically difficult to define in the work order contracts, are not as attractive to consultants, and are in line with ODOT's current internal capabilities.
- Outsourcing decisions for modernization projects should be made on a project-by-project basis, dependent on specific project characteristics. Modernization projects may be effectively delivered in-house or through one of the outsourcing methods.
- Design-build project delivery has advantages for projects that must be delivered on an aggressive schedule. If schedule sensitivity is normal, in-sourced design-bid-build or outsourced design-bid-build project delivery is preferred over outsourced design-build.

The research findings were also used to develop a decision tree to provide a guideline for ODOT to use in deciding whether highway construction projects would be better suited to insourced: design-bid-build; outsourced: design-bid-build, or design-build.

KEEPING PROJECTS ON SCHEDULE

On time completion of research projects is both important and challenging. For a number of years, Research has tracked project timeliness.



Timeliness is important for a number of reasons, but apart from the obvious, prompt completion is a major factor in successful implementation of research. Given the fast pace of change within ODOT, champions for research implementation move on and circumstances change. This can often leave the Research Unit's product without a customer.

While on time delivery of research is important, it is also difficult. More often than not, the true requirements are not apparent until work is underway, leading to changes in scope. Also, most work is contracted through Oregon universities. University faculty and graduate students are part time researchers with competing priorities.

As is evident from the chart to the left, since FY 2002 the percent of projects that are on schedule has increased slowly but steadily. Research's original goal of 75% was exceeded in FY 2005 and has continued to improve.

POSITIONING TO COLLABORATE

Apart from selecting, developing, carrying out and implementing research, FY 2007 was an important year to the extent that methods of doing business changed in several significant ways. These changes were brought about by ODOT's partnership with OTREC, Oregon's newly established National University Transportation Center. OTREC is one of 10 National University Transportation Centers. OTREC is based at Portland State University, but other Oregon universities participate. Each year OTREC receives up to $3.5 million to fund transportation research and education, to be carried out by faculty at participating institutions.

For many years ODOT has contracted with Oregon universities for applied research. The important change is that qualifying ODOT projects are eligible to also receive funding through OTREC.

Collaboration with OTREC is not expected on every project. UTC's have certain federally mandated

requirements that do not coincide perfectly with the research mission at ODOT.

It is expected that in the long term, between 25% and 35% of ODOT's research will be jointly funded by OTREC. This, of course, means that ODOT's research resources will go further. However, it also mandates some changes in ODOT's approach to selecting and managing projects.

To collaborate more effectively with OTREC, the Research Unit has implemented several changes:

- The project selection timetable was changed to identify high priority research ideas earlier in the process.
- University investigators have been invited to become engaged in the project selection and development process earlier, so that OTREC proposals can be developed in parallel with ODOT's selection process.
- Accommodations were made to support greater flexibility in project selection, to maximize opportunities for collaboration. This has, in effect, introduced a third "clearing house" stage of project selection, which balances initial project rankings against opportunities for OTREC funding.

In the first round of project selection (Federal FY 2007) the Research Unit was able to agree with OTREC to jointly fund 10 proposals, representing savings to ODOT of more than $650,000 over the life of those 10 projects, assuming second and subsequent years' funding is also approved by OTREC.

A second major effort aimed at improving collaboration is taking place with neighboring states. Starting in October 2005, UTC Directors and state DOT research program managers in the four states making up USDOT Region X (Alaska, Idaho, Oregon and Washington) began meeting to form the Region X Transportation Consortium. The group includes;

- A representative from the state DOT research programs in Alaska, Idaho, Oregon and Washington.
- Transportation Northwest, a Regional UTC, housed at the University of Washington, but also including Washington State University.
- The National Institute for Advanced Transportation Technology (NIATT) at the University of Idaho.
- The Alaska University transportation Center (AUTC) at the University of Alaska Fairbanks.
- The Oregon Transportation Research and Education Consortium.

The impetus to form this group came initially from Nancy Nihan, Director of Transportation Northwest, which has been the Region 10 UTC since the mid-1980's. The four states had a long standing record of collaboration through Transportation Northwest. The establishment of a UTC in each of the four states could have brought about an end to that legacy of regional cooperation. The creation of the Region X Transportation Consortium was largely motivated to preserve it.

This group has met face-to-face five times now, and various subcommittees are working on specific subtasks via e-mail and conference call. Several initia-

tives of the Region X Consortium have been formed and are under-way.

A draft Memorandum of Understanding (MOU) is in review and will soon be finalized. The MOU will state intentions and goals, define governance and membership and establish procedures for the consortium. As currently drafted, the intentions and goals include:

- Exchange information on research and educational needs, interests, and programs.
- Promote interest in transportation related fields within the region.
- Leverage research funding through pooled fund projects and other partnerships.
- Develop shared educational and training programs.

On a broader level, the Region X Transportation Consortium is building on the legacy of Transportation Northwest, to advance familiarity, and build the trust necessary to support sharing and collaborative problem solving within the region.

Table 4.2: USDOT Region X Transportation Consortium UTC and DOT Members

	Washington	Oregon	Alaska	Idaho
UTC	TRANSNOW TRANSPORTATION NORTHWEST	OTREC	UAF INE AUTC	NIATT
DOT	Washington State Department of Transportation	RESEARCH	TRANSPORTATION & PUBLIC FACILITIES STATE OF ALASKA	IDAHO TRANSPORTATION DEPARTMENT

III. OTHER PROJECTS, COMPLETED & ONGOING

COMPLETED PROJECTS

Innovation in Environmental Streamlining

A variety of federal and state laws govern transportation improvement projects. Streamlining of the permitting processes of multiple agencies and levels of government can significantly reduce the time and costs of delivering such projects. This research examined an innovative program in Oregon for environmental streamlining: the OTIA III State Bridge Delivery Program.

The Bridge Delivery Program utilized a collaborative, innovative approach to environmental streamlining in addressing the huge task of repairing or replacing hundreds of cracked bridges on Oregon highways. The program's success resulted in Oregon receiving three national awards in 2005.

ODOT Research undertook a study that examined the efforts undertaken, methods used, obstacles encountered, accomplishments, and lessons learned to help gain an understanding of how the Bridge Delivery Program succeeded and the ways in which the same elements might be replicated in other settings.

The research collected case study data using semi-structured interviews of key participants in the Bridge Delivery Program and other key personnel in ODOT. Interview data were coded for patterns or similarities in responses in order to identify trends in perceptions as well as key observations. The case study identified nine significant lessons learned in the environmental streamlining process developed by the Bridge Delivery Program:

- Take advantage of urgency to bring about change.

  A crisis often acts as a catalyst to facilitate changes. Oregon's bridge crisis forced ODOT and the other agencies to look for innovative ways to handle the workload.

- Have a solid strategy for selling the program.

  Developing a winning strategy for economic benefits, green bridges, and environmental streamlining probably helped obtain buy-in and secure funding both internally and externally.

- Work with stakeholders and partners to create a shared vision.

  This included bringing together a full range of stakeholders and the regulatory and resource agencies needed to help develop environmental streamlining.

- Ensure leadership commitment at top levels.

  ODOT and its consultants brought executive-level staff together at the workshops to endorse the process; to signal that it was all right to collaborate in order to find new, more efficient ways

of doing business; and to set up expectations that a workable program would emerge.

- Involve entrepreneurial, well-regarded staff.

  It is important that those selected as collaborative agents be staff who have a history with the home agency and are perceived as having solid core organizational values, yet are also enterprising about seeing beyond traditional approaches to problem solving.

- Develop an outcome-based outlook.

  Allowing discretion to determine the means of project design and implementation, as long as the ends meet rigorous performance standards, builds in greater flexibility for project delivery.

- Create a tiered process for negotiation.

  The Bridge Delivery Program used an innovative, tiered strategy for dealing with uncertainty and potential disputes. This approach allowed staff from the partner agencies to continue developing other parts of the program while issues in dispute or in need of clarification were being resolved at the appropriate management level.

- Be aware of how language, learning, laws and norms may influence interactions.

  It is important to discuss these differences in order to resolve problems that may arise from misunderstandings and incorrect assumptions, which people from different professions may develop regarding collaborative partners.

- Provide training and education, both externally and internally.

  Program development should include sufficient resources to develop an in-house educational plan with a consistent message that will reduce the inevitable doubts and misconceptions regarding program details and potential benefits.

The research helped identify factors relevant to other transportation programs using environmental streamlining. The strength of ODOT's Bridge Delivery approach was not just in how it is changing the way ODOT does business, but in its potential to serve as a template for other DOT programs and even other agencies looking to improve environmental streamlining or other kinds of interagency coordination.

Evaluation of the Oregon DMV Driver Improvement Program

The purpose of the ODOT-Driver and Motor Vehicle (DMV) Services Driver Improvement Program (DIP) is to improve traffic safety by temporarily restricting unsafe drivers (as indicated by their crash involvement and number of traffic convictions), or removing them from Oregon's highways through the suspension process. In January 2002, new programs were implemented for adults and for drivers under 18 that substantially changed the previous program. The changes were a result of a decision by the Oregon Attorney General to prohibit the use of highway funds for activities such as warning letters and interviews that did not *directly* restrict driving privileges.

Researchers at Portland State University evaluated the effectiveness of the new adult DIP in improving safety. Oregon DMV requested the research in order to determine which areas of the program were effective

and which areas needed to be reevaluated and enhanced or eliminated entirely.

An evaluation of driving records of both suspended and non-suspended drivers was conducted. The incidence of crashes and traffic convictions of DIP subjects in the 18 month periods prior to and following suspension was compared to the incidence of these events among the driving population in general. The evaluation provided statistical comparisons on crashes, traffic convictions, and major traffic convictions.

The researchers thoroughly reviewed the statutes and administrative rules related to Oregon's current and previous driver improvement programs, compiled information on other states' similar programs, and assessed results. This information, along with the results of the statistical analysis, was the basis for the following recommendations:

- Consider reinstating warning letters. The literature supports warning letters as a cost effective safety countermeasure. Additionally, warning letters may enhance the perceived fairness of the DIP.
- Consider assigning greater weight to crashes in the DIP point system. Future crash risk is significantly related to prior crashes, but not significantly influenced by prior convictions.
- Consider assigning a reduced weight to multiple Type A convictions occurring at the same time. Future crash and conviction risk is lower when prior convictions are concentrated in fewer events.

Oregon DMV is currently assembling an advisory committee of stakeholders to review potential changes to the adult Driver Improvement Program. The advisory committee will include representatives from different service groups within the DMV, law enforcement, the judicial administration, and individuals who have been suspended under the DIP. The research report will provide background information and focus for this effort.

Truck Load Model for Oregon

Oregon State University conducted research for ODOT to examine truck traffic and truck loads on Oregon highway bridges. Researchers examined ODOT's weigh-in-motion (WIM) data to re-evaluate bridge restrictions and update customized live load factors for Oregon specific Load and Resistance Factor Ratings (LRFR). The LRFR is the current state-of-the-art approach to load rating bridges. The method is supported both by the Federal Highway Administration and the American Association of State Highway and Transportation Officials. The LRFR method incorporates live-load factors that account for statistical variation of vehicle weights and probabilities of multiple trucks on a bridge at the same time. Though there are established LRFR guidelines for truck traffic nationwide, the code allows for individual states to develop live-load factors specific for the locality using the same structural reliability methods applied in the code.

Analysis of the WIM data included factors that distinguished traffic direction, freight route type (interstate or state), truck volume, annual seasons, locality, and sampling effects. It was found that, overall, Oregon's heavy truck traffic showed low statistical variation with few overloaded trucks compared to the national average. Factors that may have contributed to this include: ease of accessibility to Oregon's overweight permits; low cost of permits; a large number of such permits authorized; severe penalties for non-compliant vehicles; and incentive breaks for load compliance. One incentive is the weight mile tax that results in lower tax for loads placed on more axles, fostering the "Trusted Carrier" program that promotes load compliance.

Oregon-specific live-load factors were less than those nationally provided by the LRFR. Using the new factors, ODOT can achieve higher load rating values, which translates into fewer bridge load restrictions and subsequent repairs or replacement. Following Federal Highway Administration approval, the customized live-load factors were incorporated into ODOT's load rating policy. As long as the statistical basis for the factors does not change, ODOT will be able to use the less stringent factors that still maintain the same level of safety as the rest of the nation.

Results of the research not only provided updated specific load ratings for ODOT bridges but were also used to provide input for the ODOT Mechanistic Empirical Pavement Design Guide (MEPDG). As ODOT moves to the MEPDG, engineers will require truck load information to be inputted into the MEPDG software. Oregon-specific data should improve accuracy of the design process.

Water Quality Facilities Investigation

A broad array of environmental protection laws and regulations have defined that proper stewardship of a transportation system includes the monitoring of storm water runoff. In response to this need, a research project was developed that created a template for writing storm water monitoring plans. The template is intended to serve as a means of streamlining the path to developing future monitoring plans in response to stewardship and compliance demands. Included with the template is a list of useful reference material for customizing an individual plan for a specific facility.

The research project, in addition to producing a practical monitoring plan template, was useful in highlighting the immense logistical and labor burdens that traditional grab sampling during precipitation imposes. Given the large number of storm water handling facilities that are simultaneously affected by a single storm it isn't feasible to monitor all facilities in the traditional manner. Creative sampling strategies will need to be developed for monitoring storm water runoff from the entire Oregon highway system.

Monitoring access to storm water facilities proved to be at least semi-problematic. There is a need to design and construct storm water facilities with access for monitoring in mind. During rainfall events attempting to regularly access a manhole that is located in a travel lane is not conducive to safety, smooth traffic flow, or efficient monitoring. Significant savings will result if ease of maintenance and ease of monitoring are given greater consideration in the design and construction of storm water facilities.

CONTINUING PROJECTS

Acoustic Emission Testing for Reinforced Concrete Bridges

The Federal Highway Administration (FHWA) requires that owners of structurally deficient bridges repair, replace, restrict truck loads or conduct analysis and testing to verify adequate integrity. Past experiments on reinforced concrete beams showed acoustic emission (AE) testing, which "hears" the "sound" given off by the material when it is damaged, to be a highly sensitive method for detecting damage. ODOT Research is developing a protocol for applying AE testing to Reinforced Concrete Deck Girder (RCDG) cracked bridges. Implementation of testing procedures would assist in rating bridge elements, determining and setting load restrictions, and predicting the rate of damage progression.

Laboratory tests of large scale beams incrementally damaged were conducted in conjunction with field tests and computer modeling. Efforts focused on determining the optimum deployment of sensors, signal filtering methods, and the best ways for interpreting data. A manual will be developed for applying AE to RCDG bridges as a means for long-term health monitoring.

Transportation Needs and Issues Survey - 2007

Every two years, since 1993, ODOT has conducted a public perception evaluation study called the Transportation Needs and Issues Survey. This survey assesses Oregon residents' current use of the transportation system, their perceptions of the system, and their top transportation related concerns.

Both state-wide and regional data analyses were conducted. Some of the topics covered by the survey included the following:

- Satisfaction with transportation services and programs
- Road conditions and road information sources
- Highway construction
- Traffic conditions and congestion
- Alternatives to automobile travel, such as transit, rail and bicycle/pedestrian routes
- Safety
- DMV issues
- Spending and funding of transportation programs, including bridge projects
- Environmental issues

The Transportation Needs and Issues Survey for 2007 has been completed. ODOT Research is in the process of preparing a report that will combine selected findings from several of the previous surveys with the 2007 data to look at trends in resident's opinions.

Drainage Facility Management System

This research project ties into a broader asset management initiative taking place both within ODOT and across the nation. The objective was to determine what was needed to inventory and manage all drainage facilities associated with Oregon's highway system. Information gathered from the inventory was collected in a database.

From among the many different drainage facilities, culverts were selected for a prototype model. Development of the software/database component was successfully handed over to the Information Systems Branch (ISB) of ODOT during the course of the project. The research project helped ISB identify the required data fields and data definitions and identify much of the required functionality. The database currently remains under development.

Pilot data gathering processes were developed and tested over a variety of geographic settings and highway classifications across the state. From this pilot effort the scope of effort required to inventory the entire state was estimated. Based on this information ODOT has contracted to begin inventorying the entire state. As this production work began, increased efficiency methods were introduced to speed up the process. One method included the estimation of obviously gentle slopes rather than an actual measurement.

Around the U.S. a number of similar efforts have been simultaneously conducted. Results of some of these studies will be incorporated into a final report for this project. Information from the production inventory work will be used to supplement and compare with what was learned in the pilot effort.

Determining Localized Anode Condition to Maintain Effective Corrosion Protection

Corrosion of steel on Oregon bridges is of major concern. One method used to prevent corrosion is cathodic protection (CP). CP systems use a continuous flow of electric current to keep corrosion away from the steel.

ODOT has installed CP systems on eight reinforced concrete bridges along the Oregon Coast. Most of the CP zones rely on a consumable zinc anode to provide protective current to the underlying steel reinforcement. As the anode ages, electrochemical reactions near the interface between the zinc and concrete partially consume the anode resulting in an accumulation of reaction products. After six to seven years of service the bond between the anode and the concrete weakens. Previous laboratory work suggests that zinc anodes in impressed current CP systems will have a life of approximately 25 years. Recent anode failures at the Yaquina Bay Bridge have shown that an anode can debond from the concrete in localized areas leaving the rest of the anode intact and functional. Corrosion protection under the debonded anode is lost.

There are methods for detecting debonded areas, such as tapping the anode surface, but there is no field-practical method to detect areas that are weakened but not yet debonded. This study was designed to

develop a practical method for determining localized anode condition for bridge preservation personnel to determine the extent of deterioration and to plan repair and maintenance strategies.

The researchers have defined three technologies that might be used for characterizing local anode condition: guided wave ultrasonic, near infrared, and a hybrid permeability and resistivity method. The guided wave ultrasonic approach, considered the most likely to be successful, will be pursued first by constructing a prototype device to test the concept.

Determining Effective Design Treatments for Transitioning from Rural Areas to Urban Areas on State Highways

Transportation agencies are seeking ways to calm traffic as it moves from high speed rural environments into developed suburban/urban areas in order to provide a more inviting environment that accommodates all roadway users – particularly bicyclists and pedestrians. This research employs a driving simulator to identify key elements in transitional traffic calming. Results of the study will summarize these elements as they relate to applicable jurisdiction, cost of implementation, and anticipated effectiveness.

Though no summary of results is available at the time of this report, a spin-off research paper based on the distracter technique used for the primary research has just recently been submitted to the Transportation Research Board. The abstract for that research is provided on the adjacent page.

The Effect of Wireless Communication and Entertainment Devices on Simulated Driving Performance

Matthew C. Crisler, Johnell O. Brooks, Jennifer H. Ogle, Chris D. Guirl, Priyanka Y. Alluri, and Karen K. Dixon

ABSTRACT

An analysis of the effect of wireless telephone communication using text and voice modalities as well as the use of an Apple IPod on lane keeping, speed, speed variability, lateral speed, and lane position variability was conducted using a driving simulator. Participants (young adult licensed drivers) drove in an unusually curvy simulated driving environment while communicating using wireless devices and controlling an IPod. As expected based on previous research, lane keeping performance was robust for voice communication tasks; however, the text messaging and IPod tasks that required significant manual manipulation of the device resulted in significant decrements in lane keeping performance. In addition, use of wireless communication devices and the IPod resulted in significant increases in speed variability throughout the driving scenario. Lateral speed increases occurred for all tasks other than the cellular phone conversation and the IPod. Increases in lane position variability were observed for the text messaging conditions. In addition to establishing the dramatic performance decrement caused by text messaging tasks, this experiment suggests that driving performance may be affected by distraction in ways not captured by lane keeping measures alone, and explores potential alternative measures of driving performance that may be useful for identifying and quantifying the effects of distracted driving.

The Older Driver in Oregon: A Survey of Driving Behavior and Cessation

The total number of persons 65 years of age and older will increase dramatically over the course of the next 20 years. In this line, the driving population, age 65 and over, is expected to double. Many of these people will choose or be forced to stop driving for one reason or another. Factors of age such as sensory and perceptual changes, cognitive changes, execution and response changes, as well as unknown effects of multiple medications, can all contribute to the impairment of driving abilities.

ODOT research conducted a study that attempted to understand the reasons for driver cessation, and address alternative transportation needs of those who had stopped driving. The survey included individuals who were currently driving as well as individuals who were no longer driving.

Data from the survey were analyzed to ascertain reasons people voluntarily stopped driving, and determine what medical or physical limitations played a factor. The survey asked those currently driving what they would perceive their experiences to be when they decided or were forced to not drive. Former drivers were asked what form of alternate transportation, if any, they used.

The study has been completed and a final report is expected at the end of September 2007.

IV. OTHER RESEARCH ACTIVITIES

In addition to major research projects, the ODOT Research program is responsible for a number of ongoing programs and activities, smaller projects, and for annual selection of new research projects.

These include:

- The Oregon T2 Center, Oregon's local technical assistance program
- Research project selection
- Small, discretionary projects
- Specific activities to support research implementation
- The experimental features program
- Selection and participation in Pooled Fund projects with other states
- Oregon's participation in the Long Term Pavement Performance (LTPP) Project
- Serving as ODOT's point of contact for national transportation research activities

The next few pages present accomplishments in some of these areas.

OREGON TECHNOLOGY TRANSFER CENTER

The T2 Center provides transportation-related information to local agencies throughout Oregon. The Center is jointly funded by FHWA, local agencies, and ODOT. T2 is one of 51 centers that make up FHWA's Local Technical Assistance Program (LTAP).

The T2 Center provides the following services:

- A Lending Library of audio/visual materials and technical publications.
- A Circuit Rider Program that provides safety oriented training on demand and also at conferences and other statewide events.
- The *Roads Scholar* Program, which offers practical training in road maintenance, operations and preservation.

- On-site informational presentations and on-call response to information requests.
- A quarterly newsletter of information on transportation-related topics.

The T2 Center strives to make local road agencies aware of the latest and most effective transportation technologies. T2 does this by acting as an information resource to encourage and strengthen communications between government agencies at all levels.

The T2 Center's *Roads Scholar* program continues to be very successful. There are currently over 800 participants in the program, and by the end of FY 2007, over 100 students had completed their Level 1 Certification. In addition, at least four local road agencies have adopted the *Roads Scholar* curriculum and/or attainment of the Level 1 Certification as a career ladder or promotion requirement. Other agencies are now offering

bonuses for achieving the Level 1 Certification. Given the interest in the program, the T2 Center is actively pursuing the development of an advanced *Roads Scholar* program.

RESEARCH PROJECT SELECTION

Research project selection is carried out in two stages. Expert Task Groups (ETGs), with support and coordination from the Research Unit staff, make initial recommendations. The ODOT Research Advisory Committee (RAC) makes the final decision, selecting projects to go forward.

Project selection starts in the fall with modifications and updates to published research priorities. (Priorities for Fiscal 2007 are in the Appendix to this report, pages 37-41.) The process ends in the spring with the annual project selection meeting.

A list of the new research projects selected for FY 2008 is shown in Table 4.1. Figure 4.1 provides a schematic of the project selection timetable. Figure 4.2 illustrates the integration of OTREC and ODOT project selection processes.

Table 4.1: New Projects Selected for Fiscal Year 2008*

Project Title	Sponsor	Duration	Cost
Safety & Operations of High-Speed Signalized Intersections	ODOT Traffic-Roadway Section	1.5 years	$114,000
Flexural Steel Anchorage Performance at Diagonal Crack Locations	ODOT Bridge Section	3 years	$353,000
Multi-Modal Investment Criteria and Freight's Economic Importance	ODOT Planning, ODOT Freight Mobility	2 years	$110,000
Copper Toxicity and ESA Listed Salmon	ODOT Geo-Environmental	3 years	$400,000
Freight Performance Measures: Approach Analysis	ODOT Planning, ODOT Freight Mobility	2 years	$110,000
Access Management Best Practices Manual	ODOT Access Management Unit	2 years	$85,000
Density Verification for Hot Mixed Asphalt Concrete Pavement	ODOT Pavement Services	2 years	$149,000
Assessment of Statewide Intersection Safety Performance	ODOT Traffic-Roadway Section	2 years	$129,000
Fuel factors	Kevin Brophy, ODOT Construction Section	2 years	$115,000
Work Zone Design and Operations Enhancements	ODOT Traffic-Roadway Section	3 years	$141,000
Fleet Condition Model Review	ODOT Fleet Services	2 years	$179,000
Oregon's ACTs, Collaboration, and Improved Planning	ODOT Planning Section	2 years	$162,500
Mechanistic Pavement Design Instrumentation	ODOT Pavement Services	2 years	$175,000

**As of July 2007 many of these projects were also proposed for funding through the new Oregon Transportation Research & Education Consortium.*

Figure 4.1

ODOT Research Project Selection Timetable

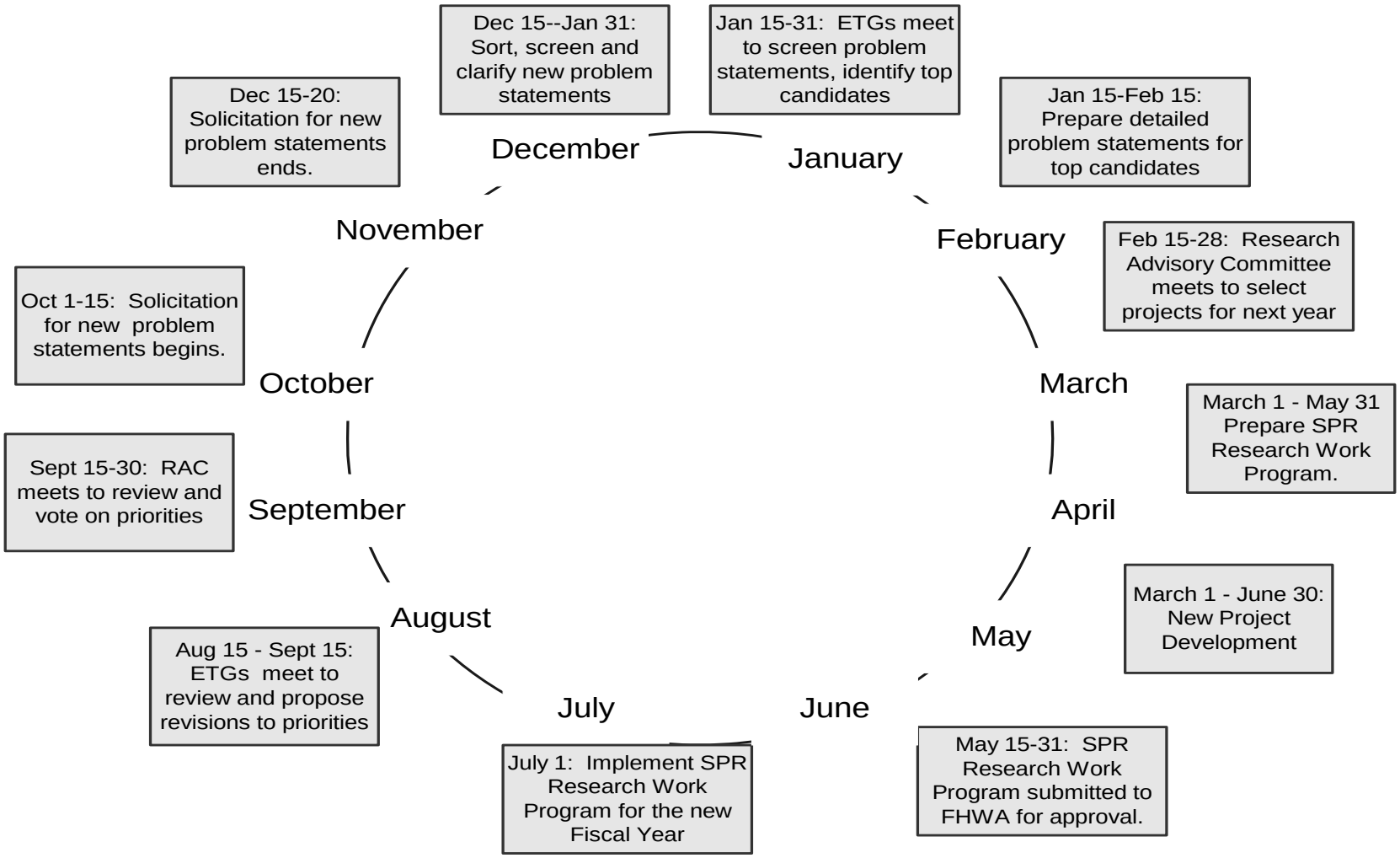
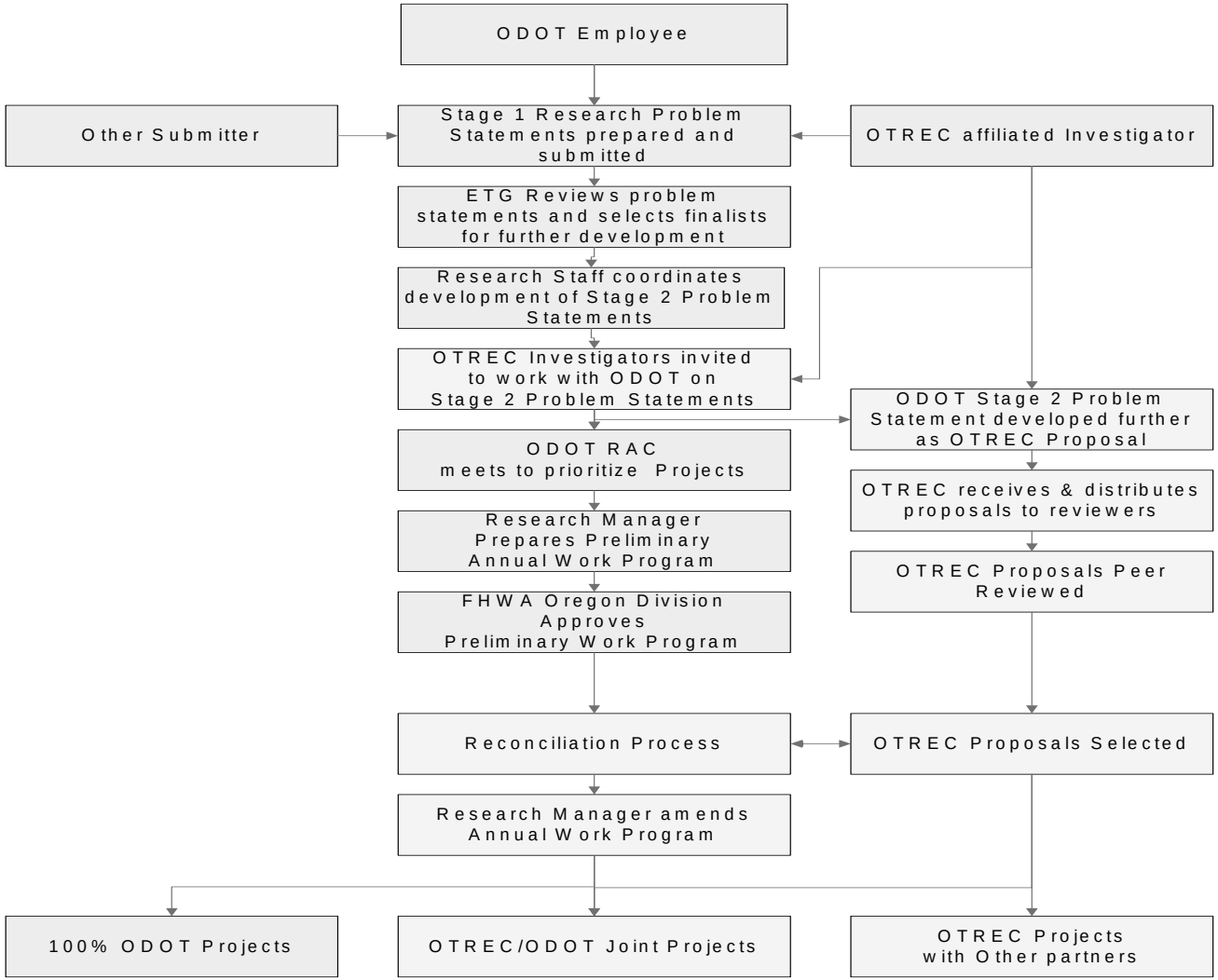


Figure 4.2

Proposed Joint ODOT/OTREC Research Project Selection Process



SMALL, QUICK RESPONSE & DISCRETIONARY PROJECTS

Each year funds are set aside for small (approx. $25,000 or less), projects and activities that can be launched fairly quickly after a proposal is received. These may be funded using SPR funds, but they sometimes use 100% state funds.

Information Requests

Research staff are periodically called upon to conduct a literature search or provide other information to ODOT staff on a particular topic and respond to requests from other states about ODOT practices. We do not track information requests, but research staff spent approximately 700 hours responding to them in Fiscal 2007, addressing such topics as the following: travel patterns of the elderly; National Personal Transportation Survey; costs to implement the truck weight-mile tax; preparing comments on reports and proposals written by other ODOT employees; and consulting on research projects led by other ODOT units.

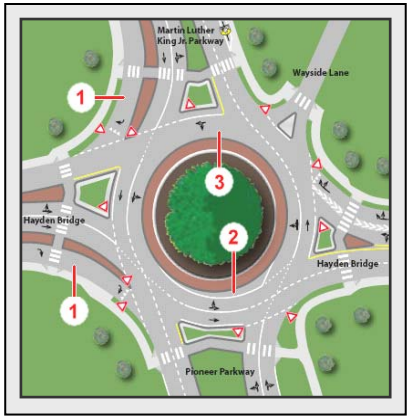
Discretionary Projects

Five small projects were active for Fiscal 2007, of which two were completed. The two completed projects were:

- Multilane Urban Roundabout
- Investigation of the Bailey Method

Multilane Urban Roundabout

Roundabouts are known to be a valuable tool in effectively managing traffic flow in a safe and aesthetic manner. Prior to 2006 there were no urban multilane roundabouts in the state of Oregon, and it was not known how drivers would react and adjust to such a roadway. But in the summer of 2006, the city of Springfield, Oregon converted one of their T-intersections into a multilane roundabout. The project site, where Hayden Road and Pioneer Parkway/Martin Luther King Jr. Parkway meet, was monitored before and after construction to see if speed variability changed and to generally determine how quickly drivers adjusted to the traffic change.



The impact of the roundabout intersection on speed variability of approaching traffic was small and mixed. Though it was originally thought that the roundabout would cause drivers to keep a more consistent speed than observed at the previous signaled intersection, speed variability did not consistently decrease. Following construction on the new interchange, traffic was observed for a six-month period at two locations where a high percentage of driver errors initially occurred. Errors caused by seeming confusion and unfamiliarity with the intersection decreased over this period. The

decrease can be correlated to a logarithmic learning curve.

The study in Springfield, Oregon showed that drivers can learn to adjust from a signaled T-intersection to a multilane roundabout. Few errors occurred after a relatively short amount of time when drivers learned and became accustomed to the traffic.

Aggregate Size and the Bailey Method

Historically, Oregon has specified gradations for dense-graded hot mix asphalt concrete using a combination of broadband limits and recommended "ideal" gradations. Selection of gradations has changed in recent years with the adoption of technologies such as SuperPave™ and Stone Matrix Asphalt. An updated method of evaluation was needed. ODOT Research conducted an evaluation of a specific gradation method called the Bailey Method, to determine if it would be useful in designing and evaluating Oregon-specific aggregate blends.

The Bailey Method is a systematic approach to blending aggregates that provides aggregate interlock as the backbone of the structure and a balanced continuous gradation of particles to complete the blend. Using this method and specified gradations, specimens were compacted and tested. Finally, rut testing was performed on those mixture specimens.

The study concluded that a modified Bailey Method analysis should be used as an additional tool to develop and select trial blends for the design of dense-graded mixes. The study noted that the Bailey Method design process led to extremely fine mixes not common in Oregon. More sieves were recommended to allow for the development of additional ratios.

RESEARCH IMPLEMENTATION

Ongoing research implementation activities through FY 2007 involved the following specific activities and accomplishments.

Research Notes

Nine research notes were published. A research note is a short, 2-4 page summary of a research project, designed to provide information of immediate usefulness directly to the user. Research Notes can be found at: http://egov.oregon.gov/ODOT/TD/TP_RES/ under "Publications."

Research Newsletter

The Research Unit first published the *ODOT Research News*, an electronic research newsletter, in the fall of 2001. The newsletter was one of a number of recommendations resulting from the 2001 Peer Exchange. The newsletter has a similar function to research notes, except that it contains more information about events and ongoing research, as well as completed research, and has a broader potential distribution.

Northwest Transportation Conference

ODOT Research will once again play an expanded role in planning and hosting the 2008 Northwest Transportation Conference (NWTC). Scheduled for February 5-7,

2008, the conference's theme will be "Making the Most of What we Have." The theme is designed to address innovations that help us to maintain and improve transportation system service levels in times of constrained funding and limited resources. In line with that theme, sessions will be developed on the following topics:

- Transportation growth management
- Operational and other innovations designed to extract more capacity from existing infrastructure
- Smart infrastructure investments
- Long life and recycled materials

We also plan to recruit nationally recognized keynote speakers to address these topics.

The Research Unit and the T2 Center plan to host display tables at the conference. Research staff will organize and chair several breakout sessions. Research staff will also assist with registration, provide audio-visual support, and judge the student poster competition.

POOLED FUND PROJECTS

FHWA allows states to cooperate to fund research through the Transportation Pooled Fund (TPF) program. This program offers significant advantages.

One advantage is cost sharing. For every ODOT dollar invested, an average of $8 has been leveraged from other states.

A second advantage is that TPF projects are approved for 100% Federal funding, which means participating states do not need to use state matching funds.

In Fiscal 2007 ODOT led one and contributed to three Pooled Fund projects (Table 4.2). The Oregon led project, Animal-Vehicle Crash Mitigation Using Advanced Technology, is summarized on the following page.

Table 4.2: Transportation Pooled Fund Project Summary

Study No.	Title	ODOT Contact	Lead Agency	Oregon 2007	Oregon Total	Total Obligated
SPR 3(076)	Animal-Vehicle Crash Mitigation Using Advanced Technology	June Ross, ODOT Research	Oregon	$0	$ 130,000	$1,350,000
TPF 5(068)	Support for Maintenance of LRFD Bridge Design Code	Bruce Johnson, ODOT Bridge	Iowa	$10,000	$40,000	$1,380,000
TPF 5(105)	Transportation Library Connectivity	Laura Wilt, ODOT Library	FHWA	$15,000	$45,000	$565,000
TPF-5(122)	Dynamic Passive Pressure on Abutments and Pile Caps	Jan Six, ODOT Geo-Hydro	Utah	$15,000	$45.000	$255,000
			Total Amount Spent	**$40,000**	**$260,000**	**$3,550,000**

Animal-Vehicle Crash Mitigation Using Advanced Technology

Oregon is the lead state for this pooled fund study in which 15 departments of transportation have participated. In August 2006, ODOT's Research Unit published the report, *Animal-Vehicle Crash Mitigation Using Advanced Technology; Phase 1: Review, Design, and Implementation*. The Phase 1 report documented work completed since the study was initiated in October 1999.

The report detailed processes for reviewing various experimental detection systems and the selection of two systems that were installed at sites near Harrisburg, Pennsylvania and at Yellowstone National Park. Included was a description of experiences with planning and design, installation, operation and maintenance, as well as results from reliability tests that were performed.

Though the field site in Pennsylvania has been excluded from the study; the site on Highway 191 in Yellowstone Park continues to operate. The Yellowstone site is being used to complete the second phase of the study, which is designed to evaluate the effectiveness of the animal detection system. Researchers at Western Transportation Institute and Montana State University continue to test the reliability of the system and are performing research to determine how the system affects the driving public. In addition to assessing changes in crash rates, researchers are conducting speed studies and completing interviews of both the public and personnel at Yellowstone National Park and the Montana Department of Transportation who have been involved with implementation of the detection system.

The study will be completed in August 2008, at which time the system will be removed. A final report is expected to be published by the end of 2008.

NATIONAL RESEARCH PROGRAM COORDINATION

ODOT participates directly or indirectly in a number of national research programs and initiatives. In general, the role of ODOT Research is that of liaison, or point of contact. Funding relationships are present. Among the responsibilities carried out by ODOT Research in Fiscal 2007 are the following.

Transportation Research Board

The Research Unit Manager is the Oregon DOT representative to the Transportation Research Board (TRB). This responsibility involves a range of duties that relate to coordination of communication and services between ODOT and TRB.

SHRP 2 Coordination

Funds provided by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) totaled approximately $150 million for the second Strategic Highway Research Program (SHRP 2). SHRP 2 is managed by the TRB and is launching ambitious programs of research in the areas of safety, infrastructure renewal, travel reliability, and transportation system capacity.

SHRP 2 will draw heavily on the expertise of state DOT personnel to review proposals and serve on project oversight panels. TRB is also launching a 'loaned staff' program to support SHRP 2 activities. To facilitate coordination, each state was asked to designate a SHRP 2 Coordinator. The Coordinator will work with SHRP 2 staff to help identify key staff to provide SHRP 2 input and assistance. For Oregon, the SHRP 2 coordinator is the ODOT Research Manager.

AASHTO Research Advisory Committee

The Research Unit Manager is also a member of the American Association of State Highway and Transportation Officials (AASHTO) RAC. The RAC has several important functions within AASHTO and in setting the national transportation research agenda, and is also the principal point of contact for transportation research between states.

The RAC meets annually. In addition, RAC members meet regionally via bi-monthly conference calls, and RAC officers meet nationally through a monthly conference call. The ODOT Research Manager was the Region 4 RAC Chair through the first half of FY 2007. Specific functions and duties of the Research Advisory Committee include the following.

Review and rating of projects submitted to the National Cooperative Highway Research Program (NCHRP)

Every year problem statements are submitted to NCHRP for funding. The TRB administers, on behalf of AASHTO and the state Departments of Transportation, have allocated a $30 million pooled fund for research benefiting highways. The AASHTO RAC member in each state is responsible for submitting an advisory ballot, used to select projects for funding.

Nomination of NCHRP project panel members

NCHRP projects are managed by a panel of experts drawn primarily from the 50 state departments of transportation. AASHTO RAC members are responsible for nominating panel members from their respective states.

Coordination of syntheses data collection

One component of NCHRP is a sub-program called NCHRP Synthesis, which consists of small studies of the state of knowledge and current practice in a particular area of highway technology. Each synthesis project will include a questionnaire survey of current practice by state Departments of Transportation. The AASHTO RAC members are responsible for coordinating that data collection within their own departments.

Other support for NCHRP

RAC members provide assistance to DOT employees who wish to submit problem statements, pay their state's annual NCHRP contribution ($417,480 for Oregon in FY 2007), and disseminate NCHRP research results within their departments.

National RAC listserv

Members of the Committee are members of an electronic mail listserv, which is used to communicate on a variety of topics. A key use that has evolved is the gathering of information about practices in other states, particularly with regard to the applications of new technology. ODOT Research coordinates hundreds of such requests for information from other states every year.

RAC officer duties

The Region RAC Chair organizes and presides at bi-monthly region conference calls and participates in monthly National RAC officers' conference calls.

The Chair also nominates or recommends individuals from Region 4 to represent the region in assorted national research related committees, activities or events.

V. PUBLICATIONS, PROJECT ACTIVITY & SPENDING

The following section summarizes activities of the Research Unit including the status of active projects, cost information and lists of reports that have been published.

RESEARCH PROJECT STATUS

The status of 76 research projects initiated from FY 1999 through FY 2007 is summarized in Table 5.1.

All reports published in FY 2007, a total of 10, are listed in Table 5.2

Table 5.3 summarizes 36 major projects that were active in FY 2007. Major projects are defined as those that were selected by the Research Advisory Committee or had a budget of at least $70,000 and a duration of at least one year.

Table 5.4 summarizes all other research projects and related activities, and includes the Research Discretionary Fund and miscellaneous continuing activities. These activities were described in Chapter 4.

Table 5.1: Project Status Summary, FY 1998 – FY 2007

Fiscal Year	Inactive		Active			Total New Projects
	Complete	Cancelled	On Schedule	Behind Schedule	In final draft	
1999	5	2		1		8
2000	8					8
2001	7	1				8
2002	4	1		1		6
2003	5		2			7
2004	10			3	2	13
2005	3		6	1		10
2006		1	5	1	1	8
2007			9			9
Total	**42**	**5**	**22**	**7**	**3**	**76**

Table 5.2: Research Reports Published in FY 2007

Author(s)	Report Title	Report #
Mark Joerger	Adjustment of Driver Behavior to an Urban Multi-Lane Roundabout	FHWA-OR-RD-07-09
James Strathman, Thomas Kimpel and Paul Leistner	Evaluation of the Oregon DMV Driver Improvement Program	FHWA-OR-RD-07-08
David N. Sillars	Establishing Guidelines for Incentive/Disincentive Contracting at ODOT	FHWA-OR-RD-07-07
Lisa Gaines and Susan Lurie	Innovation in Environmental Streamlining and Project Delivery: The Oregon State Bridge Delivery Program	OR-RD-07-06
Vincent Van Der Hyde	2004 Traveler Opinion and Perception Survey - Summary Report	OR-RD-07-05
Eric Strecker, Marc Leisenring, Wayne Huber, Matthew Mabey	Water Quality Facility Investigation	FHWA-OR-RD-07-04
Seshu B. Nummala et al.	Tsunami Design Criteria for Coastal Infrastructure: A Case Study for Spencer Creek Bridge, Oregon	OR-RD-07-03
Gary Thompson	Investigation of the Bailey Method for the Design and Analysis of Dense-Graded HMAC Using Oregon Aggregates	FHWA-OR-DF-07-02
Lisa Gaines	Transportation and the Environment: A Research Agenda for Oregon	(unnumbered)
Marcel Huijser, et. al.	Animal Vehicle Crash Mitigation Using Advanced Technology Phase I: Review, Design & Implementation	FHWA-OR-TPF-07-01

Table 5.3: Budget, Expenditures and Status for Major Projects Active in FY 2007

Project No.	Project Title	Spent in FY'2007	Expected End Date	Status
Projects Ending During FY 2007				
335	Water Quality Facility Investigation	$ 1,509	Completed	Completed
351	Models of Project Delivery	$ 52,112	Completed	Completed
630	Guidelines for Incentive Disincentive Contracting	$ 19,274	Completed	Completed
634	Effectiveness of the Driver Improvement Program	$ 55,727	Completed	Completed
500-151	Environmental Streamlining Case Study	$ 15,352	Completed	Completed
Continuing Projects				
317	Intermittent Cathodic Protection	$ 5,070	9/30/2008	Continuing
345	Effectiveness of Cathodic Protection	$ 3,392	9/30/2008	Continuing
353	Monitor Bio-engineering Stabilization Projects	$ 24,084	9/30/2007	Continuing
356	Johnson Creek Slide Project	$ 110,598	9/30/2007	Continuing
613	Culvert Condition Assessment Pilot	$ 17,543	9/30/2007	Continuing
618	Effectiveness of the Teen Licensing Program	$ 8,826	12/31/2007	Continuing
622	Abrasion Resistant Bridge Decks	$ 7,419	9/30/2010	Continuing
631	Transitions from Rural to Urban Areas on State Highways	$ 74,559	12/31/2007	Continuing
632	Premature Pavement Failure Due to Moisture	$ 73,278	5/31/2008	Continuing
633	Acoustic Emissions Testing for Reinforced Concrete Bridges	$ 70,967	6/30/2008	Continuing
635	Truck Load Model for Oregon	$ 39,948	9/30/2007	Continuing
636	Crack Repair Methods	$ 106,636	3/31/2008	Continuing
637	Low Flow Rainfall Analysis	$ 245,288	3/31/2008	Continuing
638	Wildlife Movement Study	$ 4,534	6/30/2010	Continuing

Project No.	Project Title	Spent in FY'2007	Expected End Date	Status
639	Driving Cessation	$ 58,471	12/31/2007	Continuing
641	Advisory Exit Ramp and Curve Speeds	$ 58,743	9/30/2007	Continuing
642	Mechanistic Pavement Design Input Parameters	$ 100,762	5/31/2008	Continuing
643	Corrosion of Metallic Reinforcements in MSE Walls	$ 99,718	12/31/2008	Continuing
644	Economic Assessment of Upgrades to Oregon's Short Line Rail	$ 6,564	12/31/2008	Continuing
645	Operational Benefits of System Wide Adaptive Ramp Metering System	$ 34,255	3/31/2008	Continuing
646	Alternatives to Liquidated Damages for On-time Performance	$ 76,982	12/31/2007	Continuing
650	Statistical Analysis of QC / QA data on Construction projects.	$ 2,006	12/31/2008	Continuing
651	Evaluating the Effectiveness of SIP	$ 37,718	12/31/2008	Continuing
652	Durability of FRP Repairs for Cracked RC Bridges	$ 127,346	3/31/2009	Continuing
653	Determining Localized Anode Condition for Corrosion Protection	$ 15,685	3/31/2009	Continuing
654	Waterway Enhancement Construction Methods.	$ 8,811	6/30/2009	Continuing
655	Assessing Socio-Economic Effects of Vehicle Mileage Fees	$ 38,078	9/30/2008	Continuing
656	Mapping of rainfall Analysis for Oregon	$ 38,695	12/31/2007	Continuing
657	At-Risk Driver Evaluation	$ 2,537	12/31/2008	Continuing
658	Institutional Barriers Delaying Incident Clearance	$ 2,686	6/30/2008	Continuing
500-121	Cracked Bent Caps	$ 123,417	9/30/2007	Continuing

Table 5.4: Other FY 2007 Research Activities

(Research Discretionary Fund, State Research Program, Continuing Activities)

Project #	Project Title	Spent FY 2007	Due Date	Status
Projects Ending During FY 2007				
304/500	Research Discretionary Fund and Small Projects			
304-311	Bailey Method	$ 2,036	Oct 2006	Completed
304-411	Springfield Roundabout	$ 10,303	Jun 2007	Completed
304-451	Chloride Ion Sensor	$ 3,477	Aug 2006	Completed
500-141	Northwest Transportation Conference Workshop	$ 422	Sep 2006	Completed
500-161	2005 Transportation Needs and Issues Survey Report	$ 28,074	Jun 2006	Completed
500-171	Transportation Opinions and Perceptions Survey Report	$ 31,748	Sep 2006	Completed
Continuing Projects/Activities				
300	SPR Administration	$ 14,996	ongoing	N/A
301	SPR Project Selection and Development	$193,804	ongoing	N/A
302	SPR Implementation	$ 44,344	ongoing	N/A
304/500	Small Project Development	$ 23,267	ongoing	N/A
304-121	National Research Liaison and NCHRP Activity	$ 10,876	ongoing	N/A
304-351	Travel Time Estimation	$ 15,142	Jun 2008	Continuing
304-361	Using ITS Data to Estimate Truck Travel Time	$ 293	Jun 2008	Continuing
304-431	Polymer Bridge Deck Overlays	$ 14,480	Aug 2010	Continuing
304-441	Solar Powered Barrier Markers	$ 28,868	Dec 2007	Continuing
304-481	AASHTO Technology Implementation Group	$ 6,000	ongoing	N/A
304-491	Small Business Pilot	$ 809	May 2008	Continuing
500-041	Information Requests	$ 18,045	ongoing	N/A
500-051	New Products Committee	$ 4,197	ongoing	N/A
500-071	Geo-textiles to Prevent Reflective Cracking	$ 4,322	Sep 2007	Continuing
500-181	Pooled Fund Project Coordination	$ 12,309	Jun 2009	Continuing
500-191	Regional Collaboration for Transportation Planning - Econ. Devel.	$ 4,700	Oct 2007	Continuing
500-201	Driver Cessation Survey	$ 37,516	Oct 2007	Continuing

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OTHER PUBLICATIONS

In addition to reports published by ODOT and FHWA, investigators disseminate research findings through books, journals, and conferences. Below is a partial listing of research publications and presentations that resulted directly or indirectly from ODOT research projects.

Journal and Magazine Articles

Ahn, S., Bertini, R.L., Auffray, B. and Ross, J. "Evaluating the Benefits of a System-Wide Adaptive Ramp-Metering Strategy in Portland, Oregon." *Transportation Research Record: Journal of the Transportation Research Board*, Transportation Research Board of the National Academies, Washington, D.C., 2007. (Accepted for publication)

Higgins, C., Lee, A-Y, Potisuk, T., and Forrest, R.W.B., "High-Cycle Fatigue of Diagonally-Cracked RC Bridges: Laboratory Tests," *ASCE Journal of Bridge Engineering*, March/April 2007, 12(2): 226-236.

Higgins, C., Farrow III, W.C., Nicholas, B.S., and T. Potisuk "High-Cycle Fatigue of Diagonally-Cracked RC Bridges: Field Tests," *ASCE Journal of Bridge Engineering*, Nov./Dec. 2006, 11(6): 699-706.

Howell, D. and Higgins, C., "Bond and Anchorage of Vintage Square Reinforcing Bars," *ACI Structural Journal*, 2007, 105 (3): 333-343.

Monsere, C., P. Bosa., R.L. Bertini. "Combining Climate, Crash, and Highway Data for Improved Ranking of Speed and Winter-Weather Related Crash Locations in Oregon." *Journal of Transportation Engineering*, American Society of Civil Engineers (Submitted for publication).

Monsere, C., A. Breakstone, Bertini, R.L., D. Bish. "Developing an Online Tool for Delivering Research Results: An Update to the Oregon Department of Transportation's Crash Reduction Factor Database." *Transportation Research Record: Journal of the Transportation Research Board*, Washington, D.C., 2007. (Accepted for publication)

Potisuk, T., and Higgins, C., "Field Testing and Analysis of CRC Deck-Girder Bridges," *ASCE Journal of Bridge Engineering*, Jan./Feb. 2007, 12(1): 53-63.

Sillars, D. N., "A Framework for Determining Incentive/Disincentive Amounts." *Transportation Research Record Journal*, Washington, DC., 2007 (Accepted for publication).

Sillars, D.N. and Leray, J.P.A., "Incentive/Disincentive Contracting Practices for Transportation Projects", *Alternative Project Delivery, Procurement and Contracting Methods for Highways*, K.R. Molenaar, Editor., ASCE Press: Washington, DC., 2006.

Conference Presentations/Proceedings

Ahn, S., Bertini, R.L., Auffray, B. and Ross, J. "Evaluating the Benefits of a System-Wide Adaptive Ramp-Metering Strategy in Portland, Oregon." *Transportation Research Board Annual Meeting*, Washington, D.C., January 24, 2007.

Hallowell, Matthew and Rogge, David F.. "Evaluation of Outsourcing of Project Delivery by the Oregon Department of Transportation." *Proceedings of the 2007 ASCE Construction Research Congress*, Our Lucyaya, Grand Bahamas, May 6-8, 2007.

Hallowell, Matthew and Rogge, David F.. "Evaluation of Outsourcing of Project Delivery by the Oregon Department of Transportation." *US Army Corps of Engineers Northwest District*, Oregon State University, May 2, 2007.

Higgins, C. "Tests of Full-Size Concrete Bent Caps," *ASCE Capital Section Meeting*, Salem, OR February, 2007.

Jackson, D., Immell, D., Larkins, A., and Mabey, M. "Mule Deer-Vehicle Collisions on Oregon Highways 97 and 31, a Preliminary Look at Who, Where, When, and Why." *The 2007 Joint Annual Meeting of the Oregon Chapter of the Wildlife Society and the Washington Chapter of the Wildlife Society.*

McMullen, Starr and Zhang, Lei. "Is A Vehicle-Mile Tax a Viable Alternative to the Gasoline Tax? A Review of Socio-Economics and Distributional Considerations." Annual meeting of the *Transportation Research Forum*, Boston, MA, March 17, 2007.

McMullen, Starr and Zhang, Lei. “Socio-Economics Impacts of a Vehicle Mile Tax.” *Portland State University*, May 11, 2007.

McMullen, Starr and Zhang, Lei. “Is A Vehicle-Mile Tax a Viable Alternative to the Gasoline Tax? A Review of Socio-Economics and Distributional Considerations.” *World Conference on Transportation Research*, Berkeley, CA. June 2007.

McMullen, Starr and Zhang, Lei. “Statewide Distance-Based User Charge: The Case of Oregon” *World Conference on Transportation Research*, Berkeley, CA, June 2007.

Monsere, C., Breakstone, A., Bertini, R.L., Bish, D., "Developing an Online Tool for Delivering Research Results: An Update to the Oregon Department of Transportation's Crash Reduction Factor Database." *Transportation Research Board Annual Meeting*, Washington, D.C., January 23, 2007.

Monsere, C., Bosa, P.. "Exploring Methods for Ranking Speed and Winter-Weather Related Crash Locations in Oregon by Combining Climate, Crash, and Highway Data." *Transportation Research Board Annual Meeting*, Washington, D.C., January 24, 2007.

Scholz, T.V., Huddleston, J., Hunt, E.A., Lundy, J.R., and Shippen, N.C., “Instrumentation and Analysis of a Perpetual Pavement on an Interstate Freeway in Oregon,” *International Conference on Perpetual Pavement*, September 2006.

Schumacher, T. and Higgins, C. “Application of Acoustic Emissions Testing on Concrete Column Anchorages,” *Acoustic Emission Working Group*, Berkeley, CA, 2006.

Scott, M. H., Higgins, C and Esch, G., “Reliability-Based Bridge Rating Software,” *Proceedings of 7th International Conference on Short and Medium Span Bridges*, Montreal, QC, Canada, August 2006.

Sillars, D. N., "A Framework for Determining Incentive/Disincentive Amounts." *Transportation Research Board 2007*, Washington, D.C., January, 2007

BUDGET AND FUNDING

Research funding originates from several sources:

- **Federal State Planning and Research (SPR).** SPR program funding is set at two percent of each state's FHWA highway funding under 23 U.S.C. 307(c). Of that two percent, *at least* 25 percent (i.e., 0.5%) is specifically identified for Research, Development and Technology Transfer (RD&T). For Oregon in recent years this amounts to $1.5 million to $1.9 million per year. SPR RD&T funds support a large share of direct expenditures on research projects. In addition to those funds specifically earmarked for research, in recent years the Research Unit occasionally draws project funds from the planning portion of SPR.
- **Local Technical Assistance Program (LTAP).** FHWA LTAP funding is targeted for technical assistance and training for local agency public works programs. These funds provide half the funding for the programs and activities of the T2 program.
- **Oregon Highway Fund.** These funds are used in several ways. The Research Unit uses state highway funds to cover indirect costs. Also, with some specific exceptions, SPR funds require 20% local participation. In most cases the source of these "matching" funds is the Oregon Highway Fund. Finally, a few research projects are carried out entirely with state highway funds.
- **Local Government.** LTAP funding requires 50 percent local participation. Most of these required matching funds are provided by the Association of Oregon Counties and the League of Oregon Cities. Members of these organizations are the primary recipients of T2 services.

To an increasing extent, major research projects at ODOT are jointly funded by ODOT and OTREC, in which ODOT research funds serve to meet matching or "Local Participation" requirements for University Transportation Center research funds.

There are also two ways that Federal SPR funds are accessed. When a project is budgeted and carried out by the Research Unit, ODOT applies for and receives reimbursement for the Federal share of any qualifying SPR project expense.

It is also possible to obligate Federal SPR funds to a Pooled Fund project. In this case the funds are never received by ODOT and therefore do not affect the budget; the funds are simply redirected from one Federal reimbursement account to another. This option is used to contribute to Pooled Fund projects managed by FHWA and other states.

Table 5.5 summarizes expenditures by program area and by source of funds. Figure 5.1 presents expenditures by program area in graphic form. Table 5.6 summarizes the FHWA SPR Research Funds activity during Fiscal 2007.

Table 5.5: Budget and Expenditures Summary by Program and by Source of Funds

Program	Federal			Oregon		Total
	SPR Research	SPR Planning	LTAP	Highway Funds	Local Government	
SPR Research Program	$ 1,573,169	$ 76,385		$ 412,388		$ 2,061,942
State Research Program				$ 318,663		$ 318,663
LTAP Program			$ 154,501		$ 154,501	$ 309,002
TRB Subscription	$ 26,951	$ 80,853				$ 107,804
NCHRP	$ 104,370	$ 313,108				$ 417,478
Pooled Fund led by Oregon	$ 109,581					$ 109,581
Other States Pooled Fund	$ 75,000					$ 75,000
Indirect				$ 342,632		$ 342,632
TOTAL	$ 1,889,071	$ 470,346	$ 154,501	$ 1,073,683	$ 154,501	$ 3,742,102

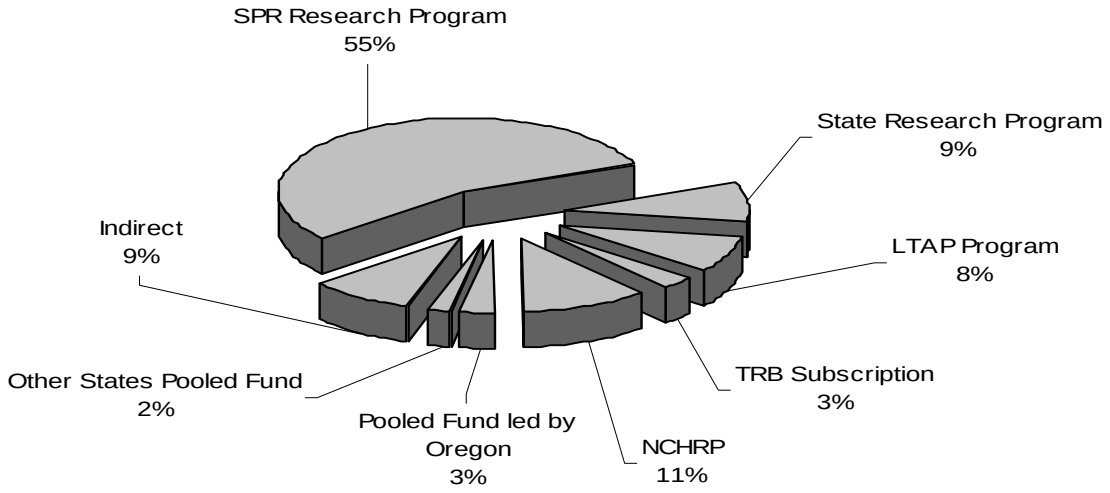

Figure 5.1: FY 2007 Research Expenditures

Note: These expenditures include both budgeted expenditures and Federal funds redirected to other organizations.

Table 5.6: Federal SPR RD&T Funds Activity in FY 2007

Income/Expenditure	Date	Amount	Balance
Income			
FY 2007 Apportionment	Oct 2006	$ 1,897,627	$ 1,897,627
Expenditures			
FY 2007 Work Program			
FY 2007 SAFETEA-LU @ 80%	Jul 2006	($ 1,596,521)	$ 301,106
To be de-obligated for FY 2007	Pending	$ 23,352	$ 324,458
Pooled Funds			
SPR 5(105) Library Connectivity	Jan 2007	($ 15,000)	$ 309,458
SPR 3(076) Vehicle-Game Animal Crash Avoidance Using Advanced Technologies	Aug 2006	($ 35,000)	$ 300,298
TPF 5(068) Long Term Maintenance of LRFD Specifications	Oct 2006	($ 10,000)	$ 274,458
TPF-5(122) Dynamic Passive Pressure on Abutments and Pile Caps	Jan 2007	($ 15,000)	$ 259,458
TPF-5(403) NCHRP	April 2007	($ 104,370)	$ 155,088
TPF-5(109) TRB Subscription	April 2007	($ 26,951)	$ 128,137
LTAP Match	N/A	($ 0)	$ 128,137
FY 2007 Net [1]			$ 128,137[1]

[1] *In fact there is a larger balance of Federal funds available, because some funds from the previous authorization carried over. The purpose of this table is simply to provide an indication of the relationship of income to expenditures.*

APPENDIX A: RESEARCH ADVISORY COMMITTEE, EXPERT TASK GROUPS AND RESEARCH PRIORITIES

RESEARCH ADVISORY COMMITTEE

The Research Advisory Committee makes final decisions on research priorities and project selection. Nine of ten voting members sit on an Expert Task Group.

Voting Members:

Jerri Bohard, *ODOT Planning Manager*
Ed Fischer, *ODOT Traffic Engineer*
Jeff Gower, *ODOT Construction Section Manager*
Bruce Johnson, *ODOT Bridge Engineer*
Barnie Jones, *ODOT Research Manager*
James Lundy, *Oregon State University*
James Strathman, *Portland State University*
Paul Wirfs, *ODOT Geo-Environmental Manager*
Lorna Youngs, *ODOT DMV Division Administrator*

Non-Voting Members:

Satvinder Sandhu, *FHWA Oregon Division*

EXPERT TASK GROUPS

Project selection in Fiscal 2006 was organized into eight subject areas. Each area has its own Expert Task Group (ETG). These groups develop and recommend priorities and screen problem statements in their areas of expertise. Membership and Fiscal 2006 priorities for each ETG are summarized below.

HYDRAULICS, GEOTECHNICAL & ENVIRONMENTAL RESEARCH

Expert Task Group:

Matthew Mabey, Chair, *ODOT Research*
Paul Wirfs, *ODOT Geo-Environmental Section*
Frannie Brindle, *ODOT Geo-Environmental Section*
Jim Norman, *ODOT Geo-Environmental Section*
Jon Guido, *ODOT Geo-Environmental Section*
Alvin Shoblom, *ODOT Geo-Environmental Section*
William Fletcher, *ODOT Geo-Environmental Section*
Michelle Eraut, *FHWA Oregon Division*

Research Priorities:

Environmental:

- **Plant Establishment -** The establishment of plants in and around Oregon's transportation system is important for easy maintenance, compliance with regulations and aesthetics. The establishment of desirable plants, such as in landscaping and wetlands enhancement, as well as the control of undesirable plants, present significant problems that might benefit from research.
- **Habitat Connectivity -** The connected network of Oregon's transportation system is superimposed on natural and manmade environments. Consequently, this results in intersections and interactions of these environments. Some of the labels given to these interactions include fish passage, wildlife crossings, and context sensitive design. Minimizing the mutual impacts of these systems or seeking mutual enhancements might benefit from research.
- **Human Environment -** Oregon's transportation system is an integral part of the human environment. To maximize its contribution to that environment issues such as hazardous materials, historical preservation, archeological investigation, and noise control need to be addressed efficiently and

effectively. Research to enhance either efficiency or effectiveness could contribute to a better environment.

Hydraulics:

- **Storm Water Management -** Modern transportation systems create extensive areas of impervious surface. Handling of precipitation that falls on these surfaces is integral to the function of the system. Key issues relating to storm water management include water quality, UICs, and corridor master planning.
- **Open-Channel Hydraulics -** Oregon's transportation system crosses or parallels rivers, streams and channels throughout the state. Coexisting with these features requires that they be included in the design, construction, and maintenance of the system. Research regarding issues such as flood plains, bridge hydraulics and bank protection could result in better designs, easier construction and lower maintenance.
- **Culverts -** Culverts of many types and sizes are part of Oregon's transportation system. Being able to assess the condition of these culverts and replace them using "trenchless" techniques are important issues that need improved solutions. Tide gates and temporary water management are additional issues regarding culverts that could benefit from research.

Geotechnical:

- **Slopes -** Slopes are transient features on the earth. For an efficient transportation system changes in slopes need to be as slow and gradual as possible. Cut slopes, embankments and natural slopes all must be addressed to achieve slow gradual changes. Research into the methods to assure or reestablish optimally slow gradual change has the potential to reduce maintenance costs and minimize disruptions of the system.
- **Walls -** Oregon's transportation system largely uses retaining walls and noise walls. Innovations in retaining walls might result in lower construction or maintenance costs or improved performance. The economy, aesthetics, and effectiveness of noise walls might be improved through research.
- **Foundations -** The entire transportation system rests on some sort of foundation. Optimizing the reliability of foundations is essential to having the best system possible. Deep foundations are often necessary. These must perform their function while being affordable to construct. Materials and methods affect both the performance and construction of foundations. Shallow foundations are equally important. Site conditions can present unique challenges for design and construction. Pavement subgrade is a type of foundation that can be challenging based on site conditions or unusual load demands. Research in these areas might improve ODOT's ability to build and maintain an efficient transportation system.

CONSTRUCTION AND MAINTENANCE RESEARCH

Expert Task Group:

Barnie Jones, *Chair, ODOT Research*
Jeff Gower, *ODOT Construction Section*
Lucinda Moore, *ODOT Office of Maintenance*
Richard Fenske, *ODOT Fleet Services*
Ron Kroop, *ODOT Dist. 2A Maintenance Manager*
Bob Doran, *ODOT District 2 Manager*
Shane Ottoson, *ODOT Region 2*
Chris Hunter, *ODOT Region 3 Construction.*
David Rogge, *Oregon State University*
Jeffrey Graham, *FHWA Oregon Division*

Research Priorities:

- Effective Roadside and Work Zone Safety
- Effective Project Delivery and Quality Assurance
- Effective Pavement Delineation
- Winter Maintenance Practices
- Efficient Maintenance Practices and Equipment

PAVEMENTS AND MATERIALS RESEARCH

Expert Task Group:

Norris Shippen, Chair, *ODOT Research*
Jim Lundy, *Oregon State University*
Elizabeth Hunt, *ODOT Pavement Services Unit*

Larry Ilg, *ODOT Pavements*
Mike Dunning, *ODOT New Products Coordinator*
Anthony Boesen, *FHWA Oregon Division*

Research Priorities:

- Identify design, materials, construction, and maintenance practices that optimize performance.
- Develop construction processes that allow construction phase completion to minimize service disruptions.
- Identify materials and construction practices that optimize application while minimizing environmental and safety risks.
- Evaluate effective project delivery and quality assurance methods

PLANNING AND ECONOMIC ANALYSIS RESEARCH

Expert Task Group:

Alan Kirk, Chair, *ODOT Research*
Jerri Bohard *ODOT Planning*
Lana Cully, *ODOT DMV*
Jennifer Dill, *Portland State University*
Victor Dodier, *ODOT Governmental Relations*
Becky Knudson, *ODOT Transportation Planning Analysis*
Michael Rock, *ODOT Planning*
Jack Svadlenak, *ODOT Financial Services*
Satvinder Sandhu, *FHWA Oregon Division*

Research Priorities:

- Planning techniques for freight movement and intermodal connectivity; including passenger and freight movement.
- Impacts of transportation improvements on economic development and employment.
- Increasing efficiencies and identification of efficiency gains in transportation through interjurisdictional partnerships and other means for passenger/freight movement, highway construction, system management, system preservation, and planning.
- Use of mobility and accessibility indicators to assess the functioning of transportation system modes in urban and rural areas and for project decision making.
- Use of cost/benefit analysis for evaluating investment alternatives across transportation modes and system performance measures.
- Planning, budgeting and evaluation tools to address the economic impacts of allocating resources to maintenance activities relative to preservation and modernization.
- Evaluation of alternative financing mechanisms for various components of the transportation system at the state, regional and local level.
- Effects of land uses, urban form and land use policies on the types, rates and demand for travel.
- Economic and demographic characteristics affecting the demand for transportation infrastructure and services.
- Incorporation of capacity gains from operational improvements into travel demand models.

TRAFFIC, SAFETY & ITS RESEARCH

Expert Task Group:

June Ross, *Chair, ODOT Research*
Ed Fischer, *ODOT Traffic Engineer*
Chris Bell, *Oregon State University*
Troy Costales, *ODOT Transportation Safety Division*
Nick Fortey, *FHWA Oregon Division*
Galen McGill, *ODOT ITS Unit*
David McKane, *ODOT Motor Carrier Services*
Christopher Monsere, *Portland State Unicersity*
Rodney Rosenkranz, *ODOT Driver and Motor Vehicle Services*
Nathaniel Price, *FHWA Oregon Division*

Research Priorities:

- **Reduce incident congestion -** Highway incidents often disrupt traffic flow, especially on congested highways. Methods are sought to: obtain and disseminate incident notification quicker; assist emergency responders to reach congested sites; enable investigators to collect better crash data faster; provide better traffic control and detours; better inform motorists to help them reach their destination; and identify and address institutional barriers.
- **Reduce congestion and improve safety in highway work zones -** Highway work zones are often the site of congestion and increased crashes. Lane closures, lane narrowing, alignment changes, delay, and speed reductions are some examples that may surprise unaware motorists. Research projects are sought that explore ways to improve mobility and safety in work zones.
- **Improve crash data analysis -** Due to limitations in crash data collection and crash analysis it is often difficult to identify crash causation and select the most effective safety improvements. Methods are sought to improve crash data collection, crash data management, crash analysis, and crash causation identification.
- **Highway system performance evaluation** - Traffic operations and safety improvements are often not validated. Methods are sought to develop performance measures and evaluation tools in the areas of traffic operations and safety.
- **Evaluate new technologies and techniques** - New traffic control or operations techniques offer the potential for improved operations and safety and reduced maintenance costs. Research projects are sought to investigate new technologies, new traffic control devices, or operations techniques that have potential to improve operations or safety or reduce maintenance costs.
- **Remove the number of unsafe drivers from Oregon roads** - The safety of Oregon's highways may be compromised by unsafe drivers. Common concerns include those who drive while under the influence of alcohol or drugs, those who have medical impairments, those who drive in an unsafe manner, and those who do not have the necessary skills or experience to drive safely. Research projects are sought to help identify effective efforts to reduce the number of unsafe drivers.

INTEGRATED MULTIMODAL RESEARCH

Expert task Group:

Vince Van Der Hyde, *ODOT Research*
Jim Strathman, *Portland State University*
Sheila Lyons, *ODOT Bike/Ped Program*
Robert Melbo, *ODOT Rail Division*
Sherrin Coleman, *ODOT Transit Division*
Jim Brock, *ODOT Motor Carrier*
Cary Goodman, *ODOT Freight Mobility Section*
Satvinder Sandhu, *FHWA Oregon Division*

Research Priorities:

- Economic trends affecting transportation demand and transportation related infrastructure.
- Impact of land use and inter-modal connectivity choices on safety at the interface of transportation modes, especially impacts on bicycles and pedestrians.
- Regional rail interconnectivity, facility siting, freight and passenger service planning and optimal route structures.
- Methods for assessing multi-modal transportation needs, capacity development, resource/supply flow, infrastructure maintenance and preservation, stressing the application of ITS.
- Development of integrated multi-modal data warehouses for research and planning use.
- Impact of multi-modal and inter-modal choices on livability, sustainability and environmental quality, including cost/benefit of these choices.
- Practical and effective transportation system security measures as they relate to anti-terrorist and homeland security in multi-modal settings.
- Congestion mitigation using multi-modal strategies.

STRUCTURES RESEARCH

Expert Task Group:

Steve Soltesz, *Chair*, *ODOT Research*
Bruce Johnson, *ODOT Bridge Engineer*
Solomon Yim, *Oregon State University*
Jeff Swanstrom, *ODOT Bridge Operations*
Scott Nelson, *ODOT Construction*
Timothy Rogers, *FHWA Oregon Division*

Research Priorities:

- Load capacity evaluation and improvement of structural members. Research emphasis is on determining the load capacity of in-place structural elements and using high performance materials to increase integrity.
- Non-destructive evaluation technologies for assessing structures. Research is aimed at developing technologies for monitoring the real-time behavior and long-term health of structures.
- Remediation of corrosion in reinforced concrete. Efforts focus on improving and characterizing cathodic protection technologies and explaining the factors that lead to premature deterioration.
- Methods for disaster mitigation. Research objective is to develop measures to reduce the impact of earthquakes and tsunamis on transportation over bridges.
- Technologies for accelerating construction. Research is aimed at structural component fabrication methods that reduce the construction time and life-cycle costs of bridges.

ROADWAY DESIGN AND HUMAN FACTORS RESEARCH

Expert Task Group:

Mark Joerger, *ODOT Research*
Lorna Youngs, *ODOT DMV*
Ann Holder, *ODOT Safety Division*
Harold Lasley, *ODOT Access Mgmt*
David Polly, *ODOT Roadway Design Section*
Karen Dixon, *Oregon State University*
Nick Fortey, *FHWA Oregon Division*

Research Priorities:

- **Urban / Suburban Design and Features** - Research on speed zone transitions, efficient traffic calming, effective roadway geometry, meaningful clear zone requirements, and urban gateways.
- **Roadside Features** - Investigations into visual issues, changing driver behavior, visual barrier improvement, and proper application of barrier systems.
- **Roadway Environmental Issues** - Optimizing roadway functionality and determining best environmental practices in roadway design.
- **Continuing Driver Education to Improve Safety and Reduce Congestion.** - Effective uses of various media to educate drivers in aspects of driving safety and more general knowledge of roadway design and usage.

RESEARCH STAFF	
Barnie Jones, *Research Manager* Construction and maintenance	**Amanda Bush,** *Research Analyst* TRIS, RIP, Publications, Field Data Collection
Matthew Mabey, *Research Engineer* Hydraulics, geotechnical and environmental	**Linda Perkins,** *Research Key Contact* Web Support, Grant Administration
Steve Soltesz, *Research Engineer* Structures	**Robert Raths,** *Technology Transfer Center Director*
June Ross, *Research Engineer* Traffic, safety, human factors	**Beth Hunter,** *T2 Assistant*
Norris Shippen, *Research Engineer* Pavements and materials	**Jack Foust,** *T2 Circuit Rider*
Mark Joerger, *Senior Research Analyst* Roadway design and human factors	**William Kolzow,** *T2 Circuit Rider*
Alan Kirk, *Senior Research Analyst* Planning and economic analysis, Publications	**Richard Young,** *T2 Circuit Rider*
Vincent Van Der Hyde, *Senior Research Analyst* Integrated multimodal, driver behavior	

For more information on ODOT's Research Program and Projects, contact

Oregon Department of Transportation
Research Unit
200 Hawthorne Ave. SE, Suite B-240
Salem, OR 97301-5192
Telephone: 503-986-2700
FAX: 503-986-2844

Or visit our website at http://egov.oregon.gov/ODOT/TD/TP_RES/

APPENDIX B: LIST OF ABBREVIATIONS

	Abbreviation	Name
A	AASHTO	American Association of State Highway and Transportation Officials
	AE	acoustic emission
	APWA	American Public Works Association
	AUTC	Alaska University transportation Center
C	CP	cathodic protection
D	DIP	Driver Improvement Program
	DMV	Driver and Motor Vehicle
	DOT	Department of Transportation
E	ETG	Expert Task Group
F	FHWA	Federal Highway Association
	FY	Fiscal Year
I	ISB	Information Systems Branch
L	LRFR	Load and Resistance Factor Ratings
	LTAP	Local Technical Assistance Program
	LTPP	Long Term Pavement Performance
M	MEPDG	Mechanistic Empirical Pavement Design Guide
	MOU	Memorandum of Understanding
N	NCHRP	National Cooperative Highway Research Program
	NIATT	National Institute for Advanced Transportation Technology
	NUTRC	Northwest Universities Transportation Research Consortium
	NWTC	Northwest Transportation Conference

	Abbreviation	Name
O	ODOT	Oregon Department of Transportation
	OIT	Oregon Institute of Technology
	OSU	Oregon State University
	OTIA	Oregon Transportation Improvement Act
	OTREC	Oregon Transportation Research and Education Consortium
P	PSU	Portland State University
R	RAC	Research Advisory Committee
	RCDG	Reinforced Concrete Deck Girders
	RD&T	Research Development and Technology Transfer
S	SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
	SHRP	Strategic Highway Research Program
	SPR	State Planning and Research
	STIP	Statewide Transportation Improvement Program
T	T2	Technology Transfer
	TPF	Transportation Pooled Fund
	TRB	Transportation Research Board
U	U of O	University of Oregon
	UTC	University Transportation Center
W	WIM	Weigh-in-motion


STOP
HERE ON
RED
10.18.1999


RESEARCH